

**Abstract:** Common bean (*Phaseolus vulgaris* L.) plays an essential role in sustaining livelihoods of smallholder farmers and their families in Africa. At farm level, beans are attacked by a combination of fungal, bacterial and viral diseases leading to poor yields. Deploying multiple disease resistant (MDR) varieties is probably the cheapest alternative in managing this problem. The overall objective of this study is to contribute to the development of MDR varieties through developing multiple disease resistance parents (MDRP) by gene pyramiding key diseases resistance genes in a common background. Using MDRP could speed up the process of developing MDR varieties as compared to use of single disease resistance sources. Molecular markers linked to resistance genes of three fungal and one viral disease were utilized. The varieties MCM5001 as sources of *l* and *bc-3* genes for Bean Common Mosaic Virus (BCMV) and its necrotic strain Bean Common Mosaic Necrotic Virus (BCMVN); G2333 as sources of *Co-4*, *Co-5* and *Co-7* for resistance to anthracnose; MLB-49-89A as source of the Pythium root rot resistance gene and MEX54 as source of *phg* for resistance to Angular leaf Spot. Single crosses between these parents were conducted and screening of up to 1500 F<sub>2</sub> plants per cross done with markers. Plants positive for two-three combination were selected and double crosses conducted between plants of differing gene combinations. Over 3000 plants of the F<sub>2</sub> progeny of the double cross are being screened to select at least 500 and maximum of 800 progeny of the root genotype with a seven gene combination of *l*, *bc-3*, *Co-4*, *Co-5*, *Co-7*, *Prr*, *phg*. Currently over 580 seeds of the four parent combination of F<sub>2</sub>[(MLB-49-89A x MEX 54) x (MCM5001 x G2333)] have been obtained. We aim to develop ideotypes with fixed multiple resistance genes that can be utilized by our partners in the next stage.

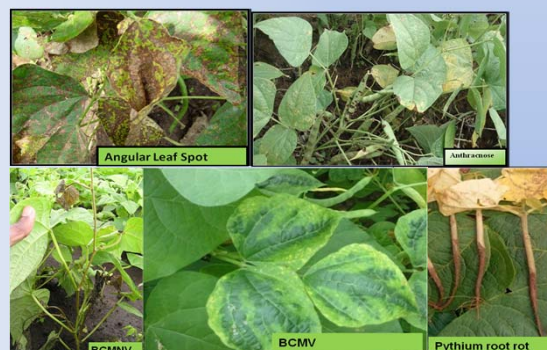


Figure 1: Some of the most common diseases of beans in Africa

### Marker Assisted Selection (MAS) and Gene Pyramiding

- MAS refers to the use of DNA markers that are tightly-linked to target loci as a substitute for or to assist phenotypic screening.
- Gene Pyramiding aims at assembling multiple desirable genes into a single Genotype.
- Molecular markers that are tightly linked to resistance genes allow for the indirect selection and ensure that useful genes are not lost during selection.

### Materials and Methods:

- Single crosses between sources of resistance (Founding parents), aim of screening up to 1500 F<sub>2</sub> plants per cross.
  - MCM5001 and MCM 1015 -*l* and *bc-3* genes for BCMV/BCMVN
  - G2333—*Co-4*, *Co-5* and *Co-7* for anthracnose
  - AND1062, MLB-49-89A, RWR 719 and SCAM 80-15 for resistance to Pythium root rot
  - MEX54-*phg* for resistance to ALS
- DNA was extracted from 2 week old F<sub>2</sub> plants.
- Two mm discs used as templates in PCR reactions using specific molecular markers.
- Plants positive for 2-3 gene combination selected and double crosses conducted amongst these plants.
- 3000 plants of the F<sub>2</sub> progeny of the double cross are to be developed and screened to select at least 500 and maximum of 800 progeny of the root genotype with a seven gene combination of *l*, *bc-3*, *Co-4*, *Co-5*, *Co-7*, *Prr*, *phg*.

A backcross program to one of the founding parents has been initiated as screening of F<sub>1</sub> proceeds.

### Results

Currently over 806 seeds of the four parent combination of F<sub>2</sub>[(MLB-49-89A x MEX 54) x (MCM5001 x G2333)] have been obtained. We aim to develop ideotypes with fixed multiple resistance genes that can be utilized by our partners in the next stage (Fig 3).

**Table 1. Molecular markers currently being utilized for Multiple disease resistance breeding in PABRA**

Trait	Markers	Source
ALS	OPE <sub>4709</sub>	MEX 54 (Mahuku et al., 2004)
	PF <sub>9250</sub>	G10474 and G10909
Pythium root rot	PYAA19	RWR719 (Buruchara et al)
	PYB08	RWR 719
Anthracnose	SAB-3	G2333 (Vallejo and Kelly, 2001)
	SAS-13	G2333 (Young et al., 1998)
	SBB-14	G2333, AB 136 (Awale and Kelly, 2001)
	SH-18	G2333 (Awale and Kelly, 2001)
BCMV	ROC11	Various
BCMVN	SW13	Various
CBB	SAP <sub>820</sub>	Miklas et al., 2000, Deidre et al., 2007

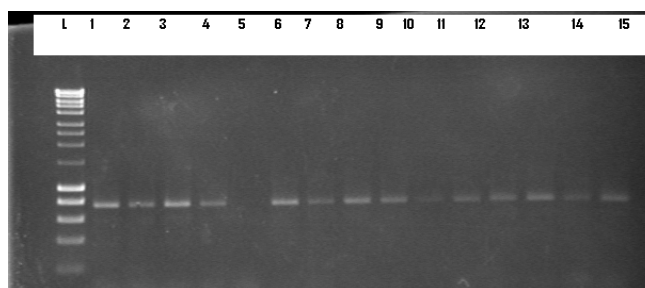


Figure 2: Part analysis of the plants from the cross G2333 X MCM1015 using the ROC 11 marker to detect presence of the recessive *bc-3* gene. Sample 5 is positive control variety MCM 5001, Sample 1 is negative control RAB 487. Absence of a band indicates presence of the gene while presence of a band indicates absence of the gene. L is 100 bp molecular marker.

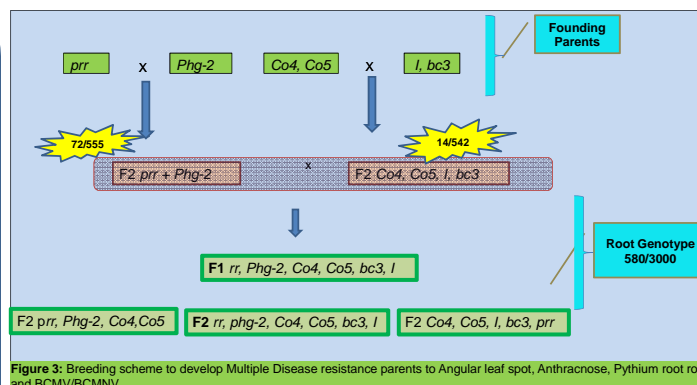


Figure 3: Breeding scheme to develop Multiple Disease resistance parents to Angular leaf spot, Anthracnose, Pythium root rot and BCMV/BCMVN

### Conclusions and Way Forward

A backcrossing program to fix the pyramided genes in an ideotype line that will be utilized by Partner breeding programs in developing Multiple constraint resistant varieties has been initiated.

### Acknowledgement

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- All partners (private, public, civil society and farmers) who are putting their effort to increase bean value chain profitability.

### References

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